Journal of the Society of Arts.

FRIDAY, APRIL 9, 1858.

CONVERSAZIONI.

The Council have arranged for two Conversazioni during the present session; the first on Saturday, the 24th April, at the Society's House, the card for which will admit the member only; the second on Saturday, the 8th May, at the South Kensington Museum, the card for which will admit the member and two friends, ladies or gentlemen. The cards for each of these evenings have been issued this day. Members not receiving them are requested to communicate with the Secretary of the Society of Arts.

Members of Institutions in Union who are anxious to attend either of these Conversazioni, are requested to apply to the Secretary of the Society of Arts, through the Secretary of the Institution to which they belong.

TENTH ANNUAL EXHIBITION OF INVENTIONS.

The Exhibition was opened on Monday last, the 5th instant.

The Exhibition will remain open every day until further notice, from 10 a.m. to 4 p.m., and is free to members and their friends. Members by ticket, or written order bearing their signature, may admit any number of persons.

EXAMINATION PRIZE FUND FOR 1858.

The following is a list of Donations up to the present date :—

	£	s	d
T. D. Acland, Member of Council		5	5
John Ames		5	5
J. G. Appold, F.R.S., Auditor		10	10
T. H. Bastard		5	0
Messrs. Chance, Brothers		10	10
R. L. Chance		5	5
Harry Chester, Vice-Pres.		10	10
J. P. Clarke		1	1
G. Clowes		10	10
Henry Cole, C.B., Vice-Pres.		1	0
H. D. Cunningham, R.N.		1	1
C. Wentworth Dilke, Vice-Pres. Chairman of Council (third donation)		10	10
Thomas Dixon		1	1
Lieut.-Col. F. Eardley Wilmot, R.A.		5	0
Lord Ebury		5	0
J. Griffith Frith, Member of Council		5	5
J. W. Gilbart, F.R.S., Treasurer (second donation)		10	10
F. Seymour Haden (annual)		2	2
William Hawksworth		1	1
Edward Highton (annual)	£	2	2
James Holmes (annual)		1	1
The Marquis of Lansdowne, Vice-Pres.		20	0
George Lowe, F.R.S.	£	1	1
The Master of the Mint, Member of Council (second donation)		10	10
George Moffatt, M.P.		10	10
Sir Thomas Phillips, Member of Council		5	5
William T. Radford		1	1
Charles Ratcliff, Hon. Local Sec. (annual)		10	10
Joseph Skey, M.D.		1	0
William Tooke, F.R.S., Vice-Pres.		10	10
Arthur Trevelyan		1	0
T. Twining, jun., Vice-Pres.		10	10
Dr. J. Forbes Watson		1	1
G. F. Wilson, F.R.S., Member of Council (third donation)		10	10

LOCAL BOARDS—PREVIOUS EXAMINATION.

Forty-seven Local Boards have been formed. Returns of the Candidates who have passed the Previous Examination have been received up to the 7th inst., as follows :—

Leeds	4
Wigan	6
West Hartlepool	3
Leeds Christian Institute, No. 1	14
Northowram	1
Portsmouth	2
Warminster	1
Banbury	2
Macclesfield	83
Newcastle-on-Tyne	3
Lymington	1

THE MULREADY DRAWINGS.

Previous to the presentation of these drawings to the National Gallery,* photographic copies of them were taken by Mr. Thurston Thompson, at the request of the Council. Mr. Thompson has arranged to supply copies to members of the Society, the price being seven shillings and sixpence for the set of three. Members desiring to have copies should communicate with Mr. Thurston Thompson, at the department of Science and Art, South Kensington, S.W.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 7, 1858.

The Seventeenth Ordinary Meeting of the One Hundred and Fourth Session was held on Wednesday, the 7th inst., Dr. Frankland, F.R.S., in the chair.

The following Candidates were balloted for and duly elected members of the Society :—

Blakeley, Capt. Alex. Theophilus, R.A.	Smith, Thos. Roger.
Hobbs, William Fisher.	Symonds, Frederick.
Seymour, Hon. F.	Vyvyan, Richard Henry Stackhouse.

The following Institution has been taken into Union since the last announcement :—

Dorking Literary and Scientific Institution.

* See the present volume of the *Journal*, p. 237.

Previous to the reading of the Paper, the Secretary announced that since the last meeting the Society had to regret the loss of two of its most valued members, Mr. Richard Horsman Solly and Mr. Herbert Minton. Mr. Solly, it is well known, took the warmest interest in the welfare of the Society for more than half a century, and was formerly among those most active in its management and most liberal in its support. At a time now nearly twenty years since, when many members had deserted it, and when it was even proposed that this Society, to which the Arts, Manufactures, and Commerce of the country owed so much, should be dissolved from want of funds, he generously came forward and assisted it. The fine picture of Adam and Eve, by James Barry, belonging to the Society, was a gift from Mr. Solly. As a patron of Art, and as a philanthropist, the name of Richard Horsman Solly stands prominently forward, and the Council feel that the loss of so old and valued a friend of the Society should not be passed over unnoticed. Mr. Solly was elected a member of the Society on the 1st of February, 1804, and died on the 31st of March last.

With reference to Mr. Herbert Minton, it should not be forgotten that when the Society first directed the attention of manufacturers to the importance of improving articles of general utility, by giving them more artistic forms with more perfect execution, that gentleman was among the first to carry into effect the improvements thus suggested. He also materially assisted the Society in its efforts to establish Industrial Exhibitions in this country; and the fine specimen of tesselated pavement in the Society's Hall, presented by him in 1846, will long remain a testimony to the skill and enterprise he displayed in developing this new industry. Mr. Herbert Minton was elected a member on the 3rd of June, 1846, and had served the office of Vice-President. He died on the 1st of the present month.*

The Paper read was :—

ON SOME POINTS IN THE CHEMISTRY OF BREAD MAKING.

By William Odling, M.B., F.C.S.

I think myself justified in bringing under your notice a subject apparently so worn out as that of bread-making, from the circumstance that one particular phase of the process is only just now beginning to receive its due share of recognition. About twelve months ago, I published a short paper in the *Lancet*, wherein I adverted to the changes which the starch of wheat flour undergoes during the process of bread-making; and I propose this evening, while glancing generally at the phenomena of panification, to direct your attention principally to these hitherto much-neglected changes of the starch, and to the means of preventing them. You know that by the processes of grinding and dressing, wheat grain is separated by the miller into several products, which are known by the names of "firsts," "seconds," "tails," "middlings," "sharps," "pollard," "bran," &c., and that the tails and middlings are frequently re-dressed, or re-ground and re-dressed, so as to afford a larger yield of flour. This flour is composed of several distinct alimentary principles, which may be roughly separated from one another by the action of water. If a mass of moistened flour be kneaded into a stiff paste, and be then well washed with water, there are produced a milky liquid, and a viscid tenacious elastic solid, which is called gluten. This gluten ought to be thoroughly washed with water, until the washings cease to be in any degree milky. When the turbid milky liquor, produced by washing and kneading the stiff paste and gluten with water, is set aside for some time, there are gradually formed an opaque white deposit and a clear supernatant fluid, which may be separated from one another by filtration. The opaque white deposit which is retained on the filter consists of starch; while the clear liquid holds in solution several substances which together constitute the extractive. These three principal components of wheat-flour, namely, the gluten, the starch, and the extractive, are capable of being separated from one another as above described with sufficient precision to allow of their estimation, and consequently we analyse flour by ascertaining the per centage amount of each of these substances. But flour being a very hygrometric body, is usually somewhat damp; and hence in comparing different samples, we are also required to ascertain the amount of water which each contains. This is done by drying the samples in a water-bath, or *in vacuo* over oil of vitrol. In addition to the above four substances we sometimes estimate two others, viz., the bran and the ash. From specimens of flour that have been badly dressed, a considerable quantity of fine bran may be obtained by careful sifting, and may then be weighed. We find that flour when burnt disappears in very great measure, but leaves a small quantity, usually less than one per cent., of a white or greyish ash, the weight of which can also be ascertained. Now the gluten, the starch, and the extractive, all exert important agencies in the process of panification, and demand a few moments' further consideration. The gluten of which we have spoken, usually called Beccaria's gluten, is a nitrogenised substance, closely allied in its chemical constitution and properties to flesh. It is essentially the flesh-forming constituent of wheat flour. It is not a pure form of vegetable fibrine, but usually contains a certain proportion of fine bran mechanically intermixed with it, a small quantity of fat which may be extracted with ether, and certain ill-defined azotised compounds, which are capable of being removed by hot alcohol. The starch of wheat flour, as obtained by analysis, is always mixed with flocculi of gluten, which deposit more slowly than does the pure starch. It also retains a portion of the fat of the grain. The pure starch is composed of organised granules, principally of two sizes; the large are about the $\frac{1}{1000}$th of an inch in diameter, have a lenticular shape, and are marked by very fine, rather indistinct concentric rings. The small granules seem to be spheroidal. The granules, large and small, are quite insoluble in cold water; but, when treated with boiling water, they swell, burst, and form a viscid liquor, which, on cooling, gelatinises. The watery extract of flour always contains vegetable albumen, dextrine, and grape or fruit sugar; it is also said to contain gum, and other proximate principles may not improbably enter into its composition, inasmuch as it has never been subjected to a thorough chemical examination. The albumen of flour is a flesh-forming nitrogenised substance. When the watery extract is boiled, the albumen coagulates in flocks, just as a very dilute solution of white of egg or animal albumen coagulates under the same circumstances. In fact, the two

* See Memoir of Mr. Minton, at page 328 of the present number of the *Journal*.

substances, vegetable and animal albumen, resemble one another very closely in constitution and properties. But the principal components of the extractive are the two very closely allied substances, dextrine and sugar. Now, both of these substances are capable of being formed from starch; and, in flour, or even in the entire grain, we can, by various processes, transform the starch, first into dextrine, then into sugar. Starch is an organised substance, and may, not improbably, have been originally formed in the seed out of some saccharine juice—sugar ranking lower than starch as an organic product. But, in wheat-grain and flour, we can only regard the sugar as resulting from a reverse process, namely, from the deterioration of starch. We find that wheat-grain, when in good condition, and also most samples of wheat flour, do not contain any sugar whatever, although sugar is very speedily formed in them by the action of water. The water always acquires a feebly acid reaction, possibly due to lactic acid, or super-phosphate of lime, and seems, by reason of this acidity, to effect a transformation of the starch. If the flour be extracted with lime water, or with alcohol, this difficulty is obviated, and we are then enabled to ascertain whether the sugar pre-exists in the flour or is a product of the action of water upon it. From my own experiments I am inclined to think that the existence of pre-formed sugar in flour is very rare. I have here appended some analyses of wheat flour.

	No. I.	No. II.	No. III.	No. IV.
Gluten	9·30	10·05	11·81	4·99
Starch	66·55	64·58	62 52	61·21
Extractive	7·47	8·45	12·05	18·23
Water	14·66	15·50	12·85	15·96

Nos. I. and II. are fine well-conditioned flours; No. III. a cheap inferior flour; No. IV., a very much damaged flour.

Until very lately it was considered by scientific men that the high quality of the flour was dependent upon the amount of gluten or flesh-forming material that it contained. But it is now perfectly certain that the bread-making value of flour, and its price in the market, are proportionate—not to the amount of gluten but to the amount of starch. The finest quality of flour, that obtained from the centre of the grain, is always poorest in azotized constituents. Hitherto starch has been the baker's criterion of excellence; gluten, the physiologist's; but Messrs. Lawes and Gilbert have maintained, with considerable reason, that the baker's criterion of excellence is physiologically correct; or, in other words, that the value of bread as food depends more upon its heat-forming than its flesh-forming function. With regard to the extractives I think I may safely say that they are inversely proportionate to the good condition of the flour, as is indicated by the above analyses. A high percentage of extractives nearly always indicates some defect in the harvesting or storing of the grain or flour.

In the manufacture of bread from flour, it is usual to employ a ferment, for the purpose of generating, within the substance of the dough, thousands of minute gas bubbles, so that the resulting loaf may prove not a hard, or tough, or clammy mass, according to its degree of moisture, but a soft vesicular and easily digestible substance. Originally, leaven or stale dough was used as the ferment, but for many years past the yeast of beer has been advantageously employed as a substitute, or rather as a partial substitute. Yeast is glutinous matter in a state of change, which state of change it imparts to the gluten of the flour or dough. Independently of any yeast, however, the gluten of dough can, in course of time, attain for itself this particular transformative condition, and it then constitutes leaven. But in the production of leaven, *per se*, the dough simultaneously acquires an offensive sour taste and smell. Now, the panary fermentation consists essentially in the mutual reaction of sugar, and of gluten in a particular state of change. The gluten of yeast and leaven is in this particular state of change, and by mere contact with one or other of these substances the gluten of fresh dough readily acquires a similar state. Hence, one great use of the yeast or leaven is to put the gluten of fresh dough into an active condition, whereby it may exert a transformative or fermentative action upon the sugar. In order to effect the necessary fermentation of the sugar, some bakers rely largely upon the gluten of yeast, but in Paris, more particularly, where bread-baking has arrived at a high state of perfection, it is customary to rely chiefly upon the gluten of the dough, and only to facilitate the action by means of yeast.

We have now to consider the nature of the change which the active gluten of the dough or yeast effects upon the sugar. Grape sugar or glucose is a body having of itself very little tendency to change. It consists of carbon, hydrogen, and oxygen, and is represented by the formula $C_{12} H_{12} O_{12}$. The following table shows also the composition of several allied substances:—

Cane sugar ...	$C_{24} H_{22} O_{22}$ or $C_{12} H_{11} O_{11}$
Grape sugar ...	$C_{12} H_{12} O_{12} + 2 H O$
Fruit sugar ...	$C_{12} H_{1} O_{12}$
Milk sugar ...	$C_{12} H^{10} O_{10} + 2 H O$
Starch, Dextrine, Leiocome, Gum, Woody fibre	$C_{12} H_{10} O_{10}$

But the nitrogenised bodies usually classed as proteine compounds, such, for instance, as fibrin, gluten, albumen, and caseine, are remarkable for the facility with which they undergo certain spontaneous changes of decomposition, and these proteine compounds, when in this state of change, are, by mere contact, capable of affecting the condition not only of fresh nitrogenous compounds, but also of grape sugar and other varieties of non-nitrogenous organic matter. The changes induced upon this last description of bodies vary with the nature of the nitrogenised substance employed, and with its degree of decomposition. Thus, stale casein or curd converts sugar first into lactic acid, and eventually into carbonic acid and butyric acid. The active gluten of yeast or leaven converts sugar into alcohol and carbonic acid, as represented in the following diagram:—

$$\begin{aligned} 2 \text{ alcohol } (C_4 H_6 O_2) &= C_8 \quad H_{12} O_4 \\ 4 \text{ carbonic acid } (C O_2) &= C_4 \quad\quad O_8 \\ \hline 1 \text{ grape sugar} \ldots &= C_{12} H_{12} O_{12} \end{aligned}$$

Pure sugar can in this way be resolved completely into carbonic acid gas and alcohol. The object of the baker in the use of yeast or leaven, is to effect this resolution or fermentation of the saccharine constituents of the wheat within the substance of the dough. A certain quantity of flour is mixed with yeast, salt, and tepid water. This constitutes the sponge, which is covered up and set aside in a warm place to undergo fermentation. In the course of an hour or so the mass swells up considerably from the generation within its substance of carbonic acid gas, large bubbles of which gradually extend to the surface and burst. With each successive burst we have a sudden falling of the sponge, followed by a gradual rising, and these alternate actions would, if allowed, continue to take place for many hours. Various other modes of making an active sponge are employed, particularly by the use of potatoes. When the sponge, no matter how formed, is in an efficient condition, the baker mixes up with it fresh portions of flour, salt, and water, which added quantities constitute the great mass of the dough. The whole is then subjected to a thorough kneading, so that the fermenting dough may permeate and affect the entire substance, and thus cause an equable liberation

of carbonic acid in every particle. The dough is set aside for a few hours, during which the fermentation proceeds. It is then kneaded a second time and weighed out into loaves, which are allowed to continue fermenting until they have about doubled their original bulk. They are then baked in the oven, within which they undergo a further increase of size. This last increase is due principally to the expansion by heat of the previously evolved gas, for the heat of the oven very speedily arrests the process of fermentation. I have alluded to this fermentation as the panary fermentation. In reality, however, such a phrase is quite unnecessary. We have only the ordinary well-known vinous fermentation of the sugar of wheat into carbonic acid and alcohol, precisely as in making distillers' wash we ferment the sugar of the malt into carbonic acid and alcohol. That the so-called panary fermentation is in reality a vinous fermentation, was, I believe, first satisfactorily demonstrated by Mr. Graham in the year 1826, from whose paper on the subject I have made the following extract: "To avoid the use of yeast, which might introduce alcohol, a small quantity of flour was kneaded and allowed to ferment in the usual way, to serve as leaven. By means of the leaven a considerable quantity of flour was fermented, and when the fermentation had arrived at the proper point, formed into a loaf. The loaf was carefully enclosed in a distillatory apparatus, and subjected for a considerable time to the baking temperature. Upon examining the distilled liquid, the taste and smell of alcohol were quite perceptible, and by repeatedly rectifying it, a small quantity of alcohol was obtained of strength sufficient to burn and to ignite gunpowder by its combustion. The experiment was frequently repeated, and in different bakings the amount of alcohol obtained of the above strength was found to vary from 0·3 to 1·0 per cent. of the flour employed." About the same time Dr. Colquhoun also found that when fermentation had ceased in a mass of dough, through an exhaustion of the sugar present, the addition of more sugar speedily reinduced the fermentation, precisely as happens in the fermentation of distillers' wash. Many calculations have been made to show the quantity of alcohol produced in the process of bread-making. These agree tolerably well with the results of Mr. Graham's experiments, the quantity of proof spirit being estimated at less than one per cent. of the flour. Yet the total quantity of alcohol produced must be enormous. It is estimated that the quantity of bread annually consumed in London yields 300,000 gallons of spirit, all of which escapes into the atmosphere. Some years ago the military bakehouse at Chelsea became famous, in consequence of £20,000 having been expended there in the fruitless attempt to collect and condense the alcohol produced.

The above-described action of the nitrogenised substance, metamorphic gluten, upon the non-nitrogenised substance sugar, is essential to the manufacture of fermented bread, and is an object of the baker's solicitude. But flour contains other nitrogenised substances than gluten, other non-nitrogenised substances than sugar. These nitrogenised substances, like gluten, readily undergo change, and thereby acquire transformative powers, not only upon sugar and dextrine, but also upon starch. The action of the nitrogenous substance, metamorphic albumen, upon the non-nitrogenous substance starch, is highly detrimental to the manufacture of bread, and is a result which, wittingly or unwittingly, the baker endeavours to prevent. My attention was first directed to this subject between two and three years ago, when I had brought to me for examination, a loaf which was sticky, saccharine, and sodden throughout, but which had been made from apparently good flour. Again, in the autumn of 1856 I received from Tring, in Hertfordshire, a sample of flour which was unadulterated, which contained the usual proportions of gluten, starch, and extractive, the latter being perhaps rather in excess, which seemed to be in good condition, inasmuch as the gluten was highly elastic and expansible by heat, which had in fact only one fault—it would not make bread. The result of the baking was a sweet, sticky, dark-coloured mass. Subsequently, through the kindness of Dr. Hillier, Mr. Pittard, and other friends, I have received several samples of flour having similar characters. Now, in these samples there occurs, during the process of bread-making, an exaggerated degree of the change which always takes place to a slight extent, and which consists in the conversion of the starch into sugar and dextrine. Mr. Warren de la Rue tells me that he has met with samples of flour in which this transformation of the starch has taken place so rapidly and completely as altogether to prevent the formation of paste for use in his manufactory. Many years ago Vogel noticed that, in the manufacture of bread from flour, although much sugar was converted into carbonic acid, and alcohol, the quantity of the sugar in the loaf nearly equalled that in the flour. But soon after, Mr. Graham and Dr. Colquhoun both showed that, during baking, a portion of the starch of flour was converted into sugar. Now this conversion is due to the presence of some albuminous ferment. We meet with certain metamorphic albuminous or caseous substances, both animal and vegetable, which agree in the circumstance of their being soluble in water, precipitable by alcohol, and inoperative after exposure to a boiling heat. Such, for instance, are the following:—

Diastase	from	malt,
Cerealin	,,	bran,
Emulsin	,,	almonds,
Ptyalin	,,	saliva,
Pepsin	,,	mucous membrane,

and many other ill-defined products. Diastase, cerealin, and ptyalin are remarkable for the rapidity with which they convert starch into dextrine and sugar. The finest wheat flour, obtained from the central portion of the grain, consists almost wholly of starch, is very free from azotised substances, and, unless badly harvested or stored, has very little tendency to undergo this change. But coarse flour obtained from the exterior of the grain, is rich in azotised substances, and more ready to undergo the glucosic deterioration, which is dependent upon an altered condition of the albumen. During the process of germination we always find the albumen of the seed to take on this condition. The process of malting consists in effecting a germination or sprouting of the barleycorn, coincidently with which the albumen of the barley undergoes a change, acquires transformative powers, receives the name of diastase, converts the starch of the seed into sugar, and is capable of effecting the same change upon a large additional quantity of starch. Now, the albumen of all wheat that has undergone a damp harvesting, or that has been sprouted from any subsequent cause, is in the condition of diastase. English wheat is very liable to suffer in this manner, and a large quantity of the wheat imported into London is in a similar condition. Dr. McWilliam, the physician to the Custom House, tells me that it is usual for a lighted candle, let into the hold of a vessel laden with corn, to be extinguished by the carbonic acid resulting from the partial germination of the cargo; and that, only a few weeks back, a man nearly died from sleeping in a cabin in which a wheat cargo was germinating. Now, wheat of this kind yields a flour from which it is scarcely possible to manufacture a presentable loaf, save by the use of some corrective agent. Moreover, when flour made from well-harvested wheat is subsequently exposed to heat and moisture, the albumen becomes metamorphic, and the production of white bread impracticable, owing to the conversion of the starch into sugar. M. Mège Mouries has recently shown that the albuminous constituent of bran is very ready to undergo metamorphosis, and to acquire transformative powers. To the substance in this condition he has given the name of cerealin, which, however, appears to be identical, or

very nearly identical, with ordinary diastase. He shows clearly that the brown colour of bread made with pollard or fine bran, is not due to the particles of bran, but to the circumstance of the cerealin effecting a conversion of the starch into dextrine or sugar. When this conversion was prevented by means presently to be described, the bran bread had a very pale orange colour, quite different to that of ordinary brown bread made by the usual method. The crumb of the bread was coloured yellow, merely by the small particles of bran disseminated through the mass.

In confirmation of M. Mège Mouries' views, a fact is recorded by Chevreul, in his report on the subject, to the effect that "a method was proposed to the French government, by means of which the whole of the flour in wheat was to be converted into white bread. This method consisted in removing the coloured skin of the grain, and it was supposed, in accordance with the prevailing opinion, that when all the coloured portions of the grain were separated, the bread obtained would be white. This method was tried, and, to the astonishment of all parties, the bread obtained was brown." The whiteness of bread does not depend solely upon the whiteness of the flour, but in great measure upon the little degree of change which the starch undergoes in baking. I have taken the finest flour, which in the ordinary way yielded unexceptionable bread, and have had it kneaded with infusions of bran and malt instead of water. The resulting loaves have corresponded exactly with those made from sprouted wheat in being brown, sticky, sweet, and scarcely eatable, owing to the conversion of the white starch into a brown sticky mixture of dextrine and sugar. In bread of good quality, the starch has undergone very little alteration. A portion of it is rendered soluble in water, but the great majority of the granules are simply swollen, not burst, and may be washed out of the bread, collected, and weighed. Vogel gives the following analysis of a wheat bread loaf:—

Sugar	3·6
Altered starch	18·0
Unaltered starch	53·5
Gluten, with some starch	20·7
	95·8

I have never estimated the amount of unaltered starch in bread, but I have frequently collected it and examined it microscopically.

Between the most perfect flours and such sprouted specimens as cannot of themselves be manufactured into a saleable bread, we have innumerable intermediate varieties. Now, it is not by any means certain that the glucogenic varieties of flour are of necessity inferior to the finest flour in their nutritive and digestive properties. There is reason to believe that all starch in its passage through the alimentary canal becomes converted into glucose or an allied substance; and there is no reason to believe that the commencement of this change out of the body is in any degree objectionable. But these flours, in proportion to their glucogenic tendencies, do not make good bread, and it becomes an object with the baker to oppose the glucogenesis as much as possible. Hence, in making bread from certain kinds of flour, he finds it necessary to add alum, or lime, or bean-meal, or some corrective substance which, from experience, he knows will cause the flour to yield a loaf presentable to the eye and agreeable to the palate. In reference to the so called adulteration of bread with alum, I need scarcely remind the members of the Society of Arts that they are not required to believe everything they have heard from the lips of gentlemen who, gasping for notoriety, have raised a popular clamour on the subject, have ascribed to themselves exclusive knowledge, and claimed for themselves instinctive infallibility. On scarcely any topic, perhaps, has there been expended so much bad chemistry, loose speculation, and, I fear, groundless defamation, as upon that of alum in bread. One gentleman, who, from his vast knowledge, felt himself impelled to write a book on the subject, describes in great detail not only how he found alum in bread, but also how he ascertained the quantity, and that by a process which could not possibly have yielded him a single particle. Another gentleman, probably of greater knowledge, inasmuch as he was impelled to write two books instead of one, disclaims altogether the process above alluded to, but bolsters up his own demands on public credulity by quoting the monstrous results obtained by its means. His predecessor, when he wished to weigh alumina, weighed a something or other without any alumina whatever; but he, more wise in his generation, does not omit the alumina, but takes care to weigh it with a good deal of something else in addition. When in a court of law a scientific witness affirms that he has detected arsenic, he is required to show that the results he obtained could not be due to any other substance than arsenic. But the alum detector of the present day contents himself with getting a whitish precipitate, which may be alumina or may be something else. Why should he trouble himself about a baker's reputation? The means for detecting and estimating alumina are of course equally certain with those for detecting and estimating arsenic; but I know of no book, devoted to food adulteration, in which a satisfactory process is given, though I admit that, in some of these books, the processes are so loosely described as to leave the authors a loophole of escape from the charge of positive error.

In illustration of the above statement, I beg to direct your attention to the following table, which exhibits the results of an examination of wheat grain and other vegetable produce.

	Number of Samples Examined.	Grains of ash used.	Precipitates formed.
Wheat	23	49 to 100	10
Bran	1	25	1
Maize	1	52·1	0
Barley	3	50	0
Wheat Straw	6	100	6
Barley Straw	3	100	0
Mangold-wurtzel bulb	2	100	0
Swede Turnip bulb	3	50	0
Swede Turnip leaf	4	25 to 54	4

The ashes were all kindly furnished me by Dr. Gilbert. The incinerations were made at the Rothamstead laboratory, and all who are acquainted with that laboratory must acknowledge the great care with which every operation is there conducted.

My object was to ascertain whether the process usually recommended for the detection of alum in bread, would not also detect alum in wheat grain and other vegetable produce that could not possibly be adulterated. The process I adopted is that known as Kuhlmann's, which is described as follows: I quote from Mitchell's "Treatise on the Falsifications of Food." "Incinerate about half a pound (3,500 grains) of bread in a crucible, and after having pulverised the ash, treat it with nitric acid. Evaporate the mixture nearly to dryness, dilute with about half an ounce of water (distilled), and add to the whole an excess of caustic potash solution; boil and filter; neutralise the filtered liquid with hydrochloric acid, and add a slight excess of ammonia. Collect the alumina thus precipitated in a filter, wash, *dry*, *ignite*, and weigh it. Every 100 grains of alumina correspond to about 467 grains of alum." Now, this is the process I adopted in my examination of the above ashes, save that in many cases I employed hydrochloric instead of nitric acid, such being, I believe, the usual practice, and what was the result? Why, out of 46 examinations I obtained in 21 instances the celebrated white precipitate, said to

be indicative of alumina and alum; so that had these samples been in a manufactured instead of the natural state, had the wheat, for instance, been made into flour, I should have been justified, according to the authority quoted, in pronouncing it to be adulterated with alum. But a subsequent examination of the precipitates I obtained, shewed that in reality they were not due to alumina at all. M. Kuhlmann's process, as above described, is possessed of rare merits. It will never fail in detecting alumina when present, and will often succeed in detecting it when absent also. The idea of weighing this *olla podrida* of a precipitate, and from its weight calculating the amount of alum present, as is gravely recommended by great anti-adulteration adepts, is too preposterous to require a moment's refutation.

Last year, a London physician wrote a letter to the *Lancet*, wherein he stated he had found nearly an ounce and a half of alum in a 4lb. loaf obtained from a very noted baker, being at the rate of 8lbs. of alum to a sack of flour; and yet the ash of this bread amounted only to 1·17 per cent., including more than 0·5 per cent. of common salt. The ash of 500 grains of bread, in which 11·37 grains of alum were detected, yielded him only 1·4 grains of sulphate of baryta, though every chemist knows it ought to have yielded more than 11 grains, inasmuch as a grain of alum furnishes very nearly a grain of sulphate of baryta; and the presence of so much common salt, of course negatives the notion that sulphuric acid had been expelled to any great extent by the incineration.

If we have had curious methods described for the detection of alum, we have also had curious statements as to the chemical effects which it produces. About twelve months ago, a very ingenious friend of mine published a report on the subject of alum in bread, and a still more ingenious gentleman so highly approved of it, that he caused the major part to be published in divers newspapers, with his own name appended at the bottom in the large capitals usually considered indicative of authorship. Well, in each of these Siamese-twin reports—for the second had no separate individuality—we have the following daringly-imaginative explanation of the effect of alum in panification:—"The chemical action of alum on moistened flour is analagous to tanning, and destroys (*pro tanto*) a considerable portion of its nutritiveness by converting it into a kind of wash leather, or spongy India-rubber. This gives it a tenacity, or toughness and firmness, enabling it to retain the thousands of little bubbles (given off by the yeast) which constitute the lightness or sponginess of the bread." I should have much liked to have shown the members of the Society of Arts some of this wonderful spongy, India-rubber, wash-leather gluten, which two gentlemen, unknown to one another, were clever enough to obtain from alumed bread. Unfortunately, however, my own experiments for its preparation were not crowned with success.

Now, from actual experiment, not from speculation, I think myself justified in saying that one very important use of alum is to prevent any undue deterioration of the starch during the process of raising and baking. If we mix a solution of starch with infusion of malt, in the course of a few minutes only the starch can be no longer detected, being completely converted into dextrine and sugar; but the addition of a very small quantity of alum either prevents altogether, or greatly retards, the transformation. The action of diastase upon undissolved starch is very gradual, but here also the interference of the alum is easily recognizable. Bread made with infusion of bran or infusion of malt is very sweet, sodden, brown-coloured, and so sticky as almost to bind the jaws together during its mastication. But the addition of alum to the dough causes the loaves to be white, dry, elastic, crumbly, and unobjectionable, both as to taste and appearance. I have found that flour, which of itself was so glucogenic as to yield bread undistinguishable from that made with infusion of malt, could, by the addition of alum, be made to furnish a white, dry, crumbly, eatable loaf. Dr. Hillier, if present, will probably remember my sending him two loaves made from a sample of glucogenic flour with which he had supplied me; the one, without alum, being brown, wet, sweet, and sticky, the other, with alum, being white, dry, crumbly, and unobjectionable. The specimens on the table exhibit the same differences in appearance. Of course, the worse the character of the bread which the flour yields *per se*, the more striking the effect of the alum. Now, that alum does oppose the transformation of starch into sugar, during the process of bread-making, is indisputable, and this action is quite sufficient to account for the whiteness, the dryness, and the non-adhesiveness that result from its employment.

Alum is said to have the power of causing bread to retain a larger proportion of water than it otherwise would. Thus, one witness, before the Select Parliamentary Committee on the Adulteration of Food, said, "supposing it could be proved that the presence of alum in bread is not directly injurious to health in any way, yet certain objections would still remain to the employment of alum; one of those objections is, that it causes the bread to hold more water than it would otherwise do, and, of course, the greater the quantity of water the less the quantity of wheat flour." And another witness said that, "bakers who used alum defrauded their customers by selling water at the price of bread." These statements certainly do not accord with my experience. I once examined the new crumb of eighteen alumed loaves, and found as a mean result 43·68 per cent. of water. I also examined, in a precisely similar manner, the crumb of seven non-alumed loaves, and found as a mean result 42·78 per cent. of water, the difference being quite insignificant as compared with the differences which subsist between the individual loaves, whether alumed or not.

The table, given on the next page, shows the detailed results. The specimens marked with asterisks did not contain alum. The table also gives the per centages of nitrogen and ash. The loaves were all two-pound loaves, obtained new, that is to say, during the day on which they were baked. The top crust of each loaf was sliced off, and then a layer, about two inches thick, removed, trimmed at the edges, and submitted at once to examination. My estimations of water accord closely with those of Payen and Johnston, but are somewhat higher than those of Lawes and Gilbert, of Maclagan, and of Christison. The mean of my nitrogen determinations corresponds closely with the results of Lawes and Gilbert, Maclagan, Playfair, and Payen.

Another reputed effect of alum is to prevent the loaves turning sour or mouldy. On this point I have no experience to lay before the Society. M. Mège Mouries lays considerable stress upon the fact that when the fermentative action of the gluten preponderates, we have sugar converted into carbonic acid and alcohol, as is desirable: but that when the fermentative action of cerealin, and, I would add, of diastase, preponderates, we have starch converted into dextrine, sugar, and lactic acid, as is most undesirable. We should infer chemically that alum, by preventing the transformation of starch, would prevent or interfere with the production of lactic acid, which seems to be produced in recognisable quantity when bread is made from inferior flour. Some of my friends, who make their own bread, have informed me that alum is necessary to prevent mouldiness, and evidence to the same effect was given before the Parliamentary Committee. We know that alum is usually added to flour paste to make it keep, but whether its preservative power depends upon its preventing the paste from liquefying by an alteration of its starch, or merely upon its preventing mouldiness, I am unable to say.

Liebig's explanation of the effect of alum in panification, corresponds as far as it goes with that which I have had the honour of presenting to your notice. Liebig says that in damp flour there is produced, by a re-action

of the gluten and starch, acetic and lactic acids, which render the gluten soluble in water, and that alum and

	Price in Pence.	Per centage of Water.	Per centage of organic matter	Per centage of mineral matter or ash.	Per centage of ash in dry Bread.	Per centage of Nitrogen in new Bread.	Per centage of Nitrogen in dry Bread.
1	4¾	43.03	55.48	1.49	2.61	1.83	3.21
2	3½	42.86	56.07	1.07	1.87	1.47	2.57
3	3½	44.81	53.74	1.45	2.62	1.89	3.42
4	3½	46.71	52.12	1.17	2.19	1.14	2.13
5	4	45.42	53.24	1.34	2.45	1.66	3.05
6	4	44.33	54.29	1.38	2.47	1.04	1.88
7*	4	44.41	54.38	1.21	2.17	1.06	1.90
8	3¾	38.62	59.79	1.59	2.58	1.15	1.47
9*	3¾	42.77	56.00	1.23	2.15	1.31	2.29
10	4	43.67	55.09	1.24	2.20	0.93	1.66
11*	4½	42.94	55.82	1.24	2.17	1.12	1.95
12	3¼	44.20	54.61	1.19	2.13	1.14	2.05
13	4	45.12	53.55	1.33	2.43	1.17	2.15
14	3½	44.34	54.41	1.25	2.28	1.23	2.21
15	4	43.70	55.07	1.23	2.18	1.01	1.81
16	4¾	43.06	55.59	1.35	2.39	1.24	2.18
17	4	43.90	54.92	1.18	2.11	1.13	2.03
18	4	42.12	56.65	1.23	2.12	1.23	2.14
19	4¾	42.58	55.99	1.43	2.50	1.34	2.34
20*	4¾	41.06	57.23	1.71	2.90	1.39	2.38
21*	4½	44.07	54.67	1.26	2.26	1.08	1.94
22	4	44.46	54.22	1.32	2.38	1.18	2.14
23	4¾	43.43	55.24	1.33	2.35	1.19	2.10
24*	4½	42.89	55 68	1.43	2.52	1.17	2.05
25*	4	41.34	57.76	0.90	1.54	1.33	2.27
		1085.84	1381.61	32.55	57.57	31.53	55.72
Mean.	4	43.43	55.26	1.30	2.30	1.26	2.22

other mineral salts render this gluten again insoluble. Although Liebig referred specially to the dissolved gluten, I have no doubt he really meant to include all the dissolved proteine or albuminoid substances, including, of course, the diastase and cerealin. But he does not seem to have deduced, or, at any rate, he has not referred to the consequence which would necessarily arise from this action, namely, the prevention of the metamorphosis of the starch during baking. Payen seems to entertain the same idea as Liebig. He says that "when wheat has been badly kept, or when the moist flour has become altered during its warehousing or transport, from three to six thousandths of alum are occasionally added, so as, in some degree, to restore to the gluten the consistency that it has lost." In the absence of any evidence, either from fair inference or direct observation, that the introduction of small quantities of alum into bread is prejudicial to health, it seems that the practice is not so reprehensible as is usually maintained. It certainly improves greatly the quality of bread made from inferior flour, and, in a politico-economical point of view, is important, inasmuch as it renders a large quantity of flour suitable for human food in the form of bread, which flour would otherwise have to be devoted to less important uses.

Another chemical agent, namely, lime-water, has been recommended, to effect the same result as that now accomplished by means of alum. This substance was originally recommended by Liebig, and has been used, I believe, to a considerable extent by the Glasgow bakers. Now, I would seriously advise London bakers to give lime-water a full and fair trial. Of course they know exactly how to use alum, and they would have to learn by experience how to use lime. Hence, if their earlier trials are not completely successful, they should, nevertheless, persevere. From laboratory experiments I find that lime water acts quite as efficaciously as alum in preventing the action of diastase, and the consequent transformation of starch into sugar. It seems to have scarcely any action upon the fermentation induced by yeast, or, at any rate, a much less action than alum, which, undoubtedly, retards the process somewhat. It yields a very white agreeable bread, having a rather more porous texture than ordinary bakers' loaves, and being quite free from any sourness of taste or smell. The acidity of dough, independently of its obvious disadvantages, facilitates greatly the deterioration of the starch. Starch is always converted into dextrine by a sufficient elevation of temperature—about 320 deg. Fahr., and hence, the crust of bread usually contains as much dextrine as starch. But the presence of a small quantity of free acid enables the transformation to be effected at a lower temperature, and two processes are now followed for the manufacture of dextrine upon this principle—that of M. Payen, who uses nitric acid, and that of Mr. Crace Calvert, who uses sour butter-milk, the acidity of which is probably due to the same substance as is that of dough, namely, to lactic acid. While strongly recommrecommending the use of lime-water, I yet fear that, in the practical operations of the bakery, it will prove not quite so effectual as alum in improving very inferior flour, and chiefly because it will not be possible to introduce so large a quantity into a loaf, inasmuch as a pint of water can only dissolve about 12 grains of lime. Of course, the use of lime-water will constitute an adulteration, and be stigmatized as highly immoral, inasmuch as it will enable the baker to improve the appearance of an inferior flour. Moreover, although recommended by Liebig, it will render the phosphates insoluble, and so be open to another whimsical objection. But the detection of this adulteration with lime will, I conceive, be more of a puzzle to those gentlemen who have played with the alum-question, and who have not thought it immoral to palm off their bad chemistry as a very superior article. There are, doubtless, many other mineral salts that have the same kind of action as alum, though different in degree. Thus, sulphate of copper seems to act very powerfully. I have found the addition of sulphate of zinc to yield a very white loaf; and even gypsum is not altogether without effect. An admixture of bean meal is said to exert the same action on the flour of badly-harvested wheat, as is exerted by alum. Dr. Gilbert inform me that such is really the case, but it is a point on which I have no personal experience. M. Mège Mouries, in his new process of bread-making, whereby all the meal of wheat is to be converted into wheat bread, effects the neutralisation of the cerealin by fermenting the brown meal with water in which sugar and yeast have been subjected to the alcoholic fermentation. This process prevents wholly, or to a great extent, the lactic acid fermentation that would otherwise be induced by the cerealin, and it also makes the bran to be thoroughly separated from the meal adhering to it. Then the white flour is kneaded with the fermented liquid which contains the sediment of flour separated from the bran, so as to produce a mass of dough which represents the whole farinaceous portion of the wheat. By the process of M. Mège Mouries, the deterioration of the starch is said to be prevented, and the yield of white bread from a given weight of wheat largely increased, inasmuch as the whole of the wheat is eventually separated into two products only, namely, the coarse-bran, and the fine bread. The processes are fully described in the *Compte Rendus*, for January 12th, 1857, and a very excellent abstract was published in the *Pharmaceutical Journal*, for November 1857. And now, in conclusion, I have only to thank you for your kind attention, and to express a hope that I have succeeded in rendering a common-place subject not wholly uninteresting or uninstructive.

DISCUSSION.

The Chairman said they must all have felt, whilst

listening to the admirable paper of Dr. Odling, that he had introduced a most important subject, in which they were all, more or less, directly interested. It was one which, within the last few years, had engaged the attention of many scientific men, and with very different results. There was much difference of opinion as to the latter point touched upon by Dr. Odling, namely, the adulteration of bread, as well as on the changes which took place in the process of bread-making. He saw a number of gentlemen present who were acquainted with the subject, and he hoped, as this was a favourable opportunity, the subject would be fully discussed, so that those who had held that adulteration of bread had been practised to a dangerous extent, might, if this opinion were shown to be unfounded, be relieved from further anxiety on the subject, and also that those who had held that such adulteration had not been extensively practised, might, if this were proved to be an error, be put upon their guard upon learning that considerable adulteration had taken place.

Dr. Normandy had listened with considerable interest to the clever and entertaining paper of Dr. Odling. He would address himself to the question of the adulteration of bread with alum, and he would first of all speak of the process which chemists, who knew what they were about, adopted as a test of the presence of alum in bread. It was not a process of his own contrivance, but that suggested by Kuhlmann, and which he (Dr. Normandy) had slightly modified. In his opinion that process, thus modified, was the only one which could be relied upon for the detection of alum. He would recite the process of Kuhlmann, and also mention the modifications which he conceived necessary to give unexceptional results. The process which he followed was this:—He took 1,500 grains of bread from the middle of a loaf, cutting off the crust—not that it was strictly necessary to do so—but in order to have the most convenient material to burn and crumble, the crust should be cut off. These 1,500 grains of bread he cut into thin slices, placed them on a platinum tray, and exposed them to a cherry-red heat until they became charred. When completely charred, which was known by the slices no longer burning with a flame or evolving unpleasant fumes, he took this charcoal, ground it in a mortar into a fine powder, and then returned it to the platinum tray, and exposed the powder to a cherry-red heat until it was reduced to a grey ash. He then withdrew the lamp, and moistened the grey ash with a solution of nitrate of ammonia, and applied again a red heat to the mass for the purpose of burning the last portions of charcoal remaining. Then he poured upon the ashes in the tray a few drops of hydrochloric acid sufficient to moisten them, and, in the course of a minute or two, he washed the whole in a porcelain capsule, and evaporated to absolute dryness, in order to render the silica perfectly insoluble. That was the slight modification which he considered necessary. The perfectly dry residue was then boiled in the porcelain or silver capsule with dilute caustic potash, and the whole was then thrown on a filter, and after slightly supersaturating the strongly alkaline filtrate with hydrochloric acid, carbonate of ammonia was added in excess to the filtrate thus slightly acidified, and if a white precipitate was produced, it was very probable, indeed, that it was alumina; and if, taking that white precipitate, washing it, and treating it before the blow-pipe with nitrate of cobalt, the result was an *unfused* mass of a beautiful blue colour, then he said that substance was alumina. Through the kindness of Dr. Gilbert he had obtained thirteen samples of ashes, produced, most likely, under the same conditions as those supplied to Dr. Odling, and produced, if he recollected rightly, from wheat grown in the seasons of 1849 down to 1856. He examined all of them, and on treating them in the way he had described, he did not discover the least trace of alum, nor was there a vestige of white precipitate produced after standing for twenty-four hours. With reference to the prosecutions which had been instituted against bakers for using alum in their bread, he, as a chemist, had nothing whatever to do with the question whether alum was injurious or not to the human system. His business was to answer the question put to him, "Is there alum in this sample of bread, or not?" In most cases of such prosecutions, the parties denied the use of alum, but, after analysis had proved its presence, they all had admitted that they had used it; and, moreover, alum had been seized on most of their premises, either by itself or mixed with the salt they used in the manufacture of the bread. That was sufficient, he thought, to set at rest all surmises on the subject. They might say it was impossible that alum could be present, but there it was. His invariable practice, in cases of prosecution where he was called in, was, to advise the parties to impound the bread to be analysed by another chemist, but, except in one instance in which his analysis had after all been confirmed by that of another eminent chemist, they had never availed themselves of the offer, and, as he had just said, had afterwards acknowledged that they had used alum. It had been urged that there was no positive evidence that the habitual use of alum in bread was or was not injurious; he was not called upon to decide such a question; whether it was injurious or not was a purely medical question, which it was the province of medical men to answer; all he could say was, that if they were to wait for positive evidence of the mischief caused by the use of objectionable things, there was scarcely anything the removal of which would not be successfully resisted. He had never heard of a case of a person actually dying from drinking Thames water, or that any one had been positively killed by the effluvia from the house drains. Were we, then, to leave these and other abominations undisturbed? Surely, if it was known that, when a certain substance was taken internally, its effect was to disorder the organs of digestion, we might, without great violence to our reason, say that the many cases of dyspepsia and other diseases, the origin of which was obscure or unknown, might be referred to the constant introduction, day after day, and year after year, of that substance into our food. At the same time it was necessary to be careful, before charging persons, of otherwise undoubted probity, with using deleterious substances in their manufactures, when the character of such persons depended upon the truth of such a charge; but this was another question, and, as far as he was concerned, it was a satisfaction for him to know that all the persons who had been fined in consequence of his evidence, had admitted the accuracy of the charge by pleading guilty either at once, or at some more advanced part of the proceedings. These explanations, he thought, would suffice for the present. As to the sheer incredulity with which the assertion had been met, that alum had upon two occasions been found in bread, actually in the shape of crystals, and the alleged extravagance of the fact, he had only to say, that, however unlikely this might appear, it was a fact for all that; and however clever might be the reasons adduced in proof of its improbability, these reasons were hardly sufficient to charm away that which was actually found, seen, touched, examined, and identified as alum, not only by him (Dr. Normandy) but by other chemists, whose reputation for skill and truthfulness stood at least as high as that of those incredulous persons who, however, did not venture to deny that alum was, or, until quite lately, had been used by almost all bakers, for that, unfortunately, was also a fact too well established to be in any way disturbed. With respect to the process of M. Mège Mouries alluded to in the paper, he did not think that M. Mège Mouries attributed the dark colour of the bread to the action of cerealin upon the starch. It appeared that the cerealin which existed in the perisperm of the grain, in the bran, acted upon the gluten, which it softened,

and rendered somewhat emulsive and dark, whereby a peculiar grey colour was imparted to the bread, a colour, however, unlike that of the English brown bread, which was made by an admixture of bran, and for which the name of "bran bread" would perhaps be more appropriate. The *pain bis* or grey bread of France was made from flour of second quality, mixed or not with rye flour, but there could be no question that it was the action of the cerealin upon the gluten, which, in a great measure, imparted that peculiar colour to the bread.

Dr. SNOW said that allusion had been made in the paper to a statement made by him in the *Lancet*, as to the quantity of alum he had found in bread supplied by a baker in a fashionable locality. He at the same time stated that he found much less alum in the bread supplied to the lower classes, though he had fully expected that what were called cheap bakers used more than those who supplied the inhabitants of May-fair, but such was not the case. Dr. Odling had expressed his doubts as to the quantity of alum he had detected in the bread. There might be some slight error, but he was pretty sure he (Dr. Snow) was right on the whole. He had a portion of the same bread left, and at a future time he should re-ume his investigation of the subject, and if he found that he had been wrong in the quantity of alum he had stated it to contain, he would acknowledge his error. He had many years ago come to the conclusion that the practice of putting alum into bread was a fruitful source of rickets amongst children, but he had not published his opinions on that subject. It appeared to him that rickets were more prevalent amongst children in London and the south of England than was the case in the north or in Wales, where the children were just as overcrowded and as deficiently supplied with milk as in London. The rickets were imagined to arise from a deficiency of the phosphate of lime or bone-forming ingredients in the food of the children. The bones of a child could only be hardened by the food administered to it. In the majority of cases among the working classes the chief food of the children was bread. Liebig had stated that when alum was mixed with bread the phosphate of lime in the flour was decomposed, and an indigestible phosphate of alumina was formed; and that went to show that in the great article of food of the working classes the substance necessary for the hardening of the bones of the children did not exist. He did not consider this as the sole cause of rickets in children, because it might occur from a morbid excretion of the phosphate of lime which ought to be taken up by the system. When children were supplied with sufficient milk, or eggs, or potatoes, that would assist to harden the bones. He was sorry to hear the suggestion of the use of lime-water as a substitute for alum in bread, because it would have a similarly injurious effect. It could not be denied that alum was of great advantage to the bakers in the making of bread, but it was very probable that they might find out some other ingredient equally valuable in its chemical operation, without the injurious properties of alum. He believed, however, that for grown people the admixture of a little alum was not very injurious, though for children it was so.

Mr. PITTARD said, having been indirectly alluded to as a writer on the subject of adulteration of food, he would offer one or two remarks. Dr. Odling's paper had put before them the novel and interesting discovery of the formation of a large quantity of sugar in flour of an inferior quality. It had long been known that a large quantity of sugar was found in wheat when in a state of germination, but now they had the additional fact that it was also found in flour, and it was also interesting to know that alum prevented its formation. For these reasons the paper was a valuable and instructive one. He (Mr. Pittard) had—perhaps unfortunately—stated that the effect of alum in bread was analogous to tanning, and converted it into a substance like wash-leather. They knew that if paste was made too thin, and alum was mixed with it afterwards, it made it thicker, and it was also known that borax possessed similar properties. Those facts put together, went to show a similar action to tanning. He (Mr. Pittard) was still by no means convinced that the alum did not tan the gluten of the flour. Dr. Odling had certainly gone far to say that it tanned the diastase, and had carefully abstained from saying much as to the effect, bad or good, produced by it on the human body. For his own part he and many other medical practitioners had a settled belief that alum in bread was injurious to mankind. Sickly children had been found to improve marvellously upon baked flour, whilst they pined away upon soaked bread. The chemists spoke slightingly of the medical men because they did not pretend to know the chemistry of the question, and said that they were ignorant that the alum was decomposed in the making of bread. Even if that were so, it did not prove that the alum was rendered innocuous; if alum was resolved into alumina and sulphuric acid, he did not know whether alumina might not be injurious in the body. It was a fact worthy of note that, although alumina was one of the most plentiful substances on the earth, yet it did not enter into the composition of any organic bodies whatever, whether animal or vegetable. This alone was a reason against the introduction of alum into food. With salt it was very different. They might be told that the chemical effects of alum on the animal system were not extraordinary, but there were chemical effects to be considered. Finely pulverised glass would cause the death of an animal, and yet no one would assert that it was a powerful chemical substance, though the mechanical effect upon the intestines of a dog on which the experiment was tried, was sufficient to kill it. Dr. Odling had told them it was convenient to the bakers to use alum. No doubt of that. It might make nice looking bread, but if it did great injury to those who ate this bread, it ought not to be used, any more than pernicious colouring ingredients should be used in other articles of food.

Mr. VARLEY begged to add his testimony to that of Mr. Pittard with regard to the pernicious effects of alum upon the human system, as he had found from personal experience. With respect to the admixture of alum with paste to prevent mildew, he had found that longer boiling of the paste had the same effect, whilst the action of alum on delicate tints of colour was obviated.

Mr. JOHNSTONE mentioned that during a harvest some years ago the wheat had been got in in very bad condition. The question was discussed by Professor Faraday and others, and they came to the conclusion that carbonate of magnesia would have a most beneficial effect upon it in making bread, and this would no doubt have been adopted had it not been for the expense. For many years he had used in his family bread made with hydrochloric acid and bi-carbonate of soda, which was most excellent.

Mr. T. A. MALONE said it had been mentioned that bakers had placarded their bread as having "all the gin" in it,—on the same principle let them now announce, "bread with alum in it," and people could then exercise their choice whether they would have it or not. He thought that would be the most honest way of dealing, because if the addition of alum to inferior flour made bread more presentable to the eye than that made from the best flour without alum, it was a species of fraud that ought not to be countenanced. They were told that it was still an open question whether or not alum was injurious to the human system. The same doubt prevailed with regard to the emanations from sewers, but as all sensible people avoided open sewers as much as possible, so he for his own part would wish to avoid bread with alum in it. Dr. Normandy had told them that if he obtained from the white precipitate a blue colour before the blow-pipe by the addition of cobalt, he was entitled to consider that it contained alumina, but it was known

that other matters became blue by the action of cobalt besides alum.

Dr. Normandy said it was the precipitate, obtained in the way he had described, which should be submitted to the nitrate of cobalt; and if a blue colour were obtained he felt certain that this test could be practically relied upon.

Mr. Malone added that the potash employed might allow some of the phosphates to remain, and these would give a blue colour. He believed that, unless the final precipitate were completely re-analyzed, they were not entitled to speak with certainty as to its composition.

The Chairman said some of the phosphates of alkaline earths were soluble in potash.

Mr. Malone said it had been stated that alum rendered bread light and friable; he was not sure that that was any recommendation in point of digestibility, and he was doubtful whether a more sodden mass would not be more soluble in the stomach. Milk became a coherent mass very soon after it was received into the stomach; he thought this was a point worthy of further consideration.

Dr. Gilbert said, that the subject of the propriety, or otherwise, of adding alum, and certain other matters, with the same object, to bread, was one of such great practical importance, that while there were others, as he saw there were, in the room, who had been much occupied with the question, and had not yet spoken, he felt it to be almost an improper digression to lead the attention of the audience in another direction. In obeying the call of the Chairman, he would, therefore, be very brief on the points with which he was himself best acquainted. With regard to the alum question, he suspected the truth lay somewhere between the two extremes which had been advocated by the respective speakers. He was not disposed to think that alum could be, with advantage to the consumer, added to really good flour, for the purpose of bread-making. On a large class of constitutions he thought there was medical testimony enough to show, that alum, or alumina, in bread acted injuriously. With such it induced constipation, and this was a fruitful source of more serious disease. On the other hand, it was to be remembered, that owing to the seasons, which we could not control, a considerable portion of the flour, which must be consumed by somebody, was not in a perfect condition to yield a bread of good texture and other requisite characters without the aid of some extraneous matter; and if the bread were not of suitable texture and condition, its digestion would be imperfect, and if digestion, then assimilation also. The question was then, so far as related to alum, whether or not the benefits which it undoubtedly produced, so far as the physical and some other characters of the bread were concerned, were greater or less than the evils he believed it in many cases induced. The subject required much careful consideration, and if a substance or a method, that would have the same effects in retarding the chemical changes to be avoided in flour and bread, and which at the same time was undoubtedly innocuous could be generally adopted, few would then uphold the use of alum. The suggestion of Dr. Odling to use lime-water, as recommended by Baron Liebig, was deserving the serious attention both of bakers and medical men. Dr. Odling had quoted the opinion of Mr. Lawes and himself (Dr. Gilbert), to the effect that the best flour in the estimate of the baker was that which contained a comparatively small proportion of gluten or other nitrogenous constituents, and a large amount of starch; and, further, that this estimate was a correct one, so far as the consumer of the bread was concerned. This was, in fact, the case, as matters stood; but some little amplification of the statement was needed, to avoid misunderstanding. He would not say, that a comparatively high per centage of gluten was not desirable, provided the flour had also all the other qualities requisite in a good bread flour. These depended much on physical character and chemical condition, as well as on ultimate chemical composition. Thus it happened that our home-grown wheats, and many grown under somewhat similar climatic condition, seldom at once ripened well, and yielded a high percentage of nitrogenous compounds. There were exceptional seasons; but the average was as here stated. Our wheats which ripened best were generally low in percentage of nitrogen, and high in that of starch; and the high condition, with little tendency to fermentative changes, was of more importance than the richness in nitrogen, within the limits usually occurring. The highly glutinous wheats, on the other hand, from hotter summers than our own, generally were structurally objectionable for the purposes of bread making, except in small proportion, with less matured wheats. These highly nitrogenous grains were generally very hard, refractory in the mill, not yielding either an easily workable dough, or a bread of light and open texture. From opposite causes, therefore, the highly nitrogenous wheats, as they occurred in commerce, were more or less objectionable; and hence it was, that, in practice, the flour containing a small proportion of nitrogenous matter, and a large one of starch, was generally the best, so far as the consumer was concerned. It might be added, as the result of the observation of dietaries on the large scale, that in practice the labouring classes, under the idea of improving their diet, generally first added to their bread, fatty matters of some kind, which still further diminished the relative proportion of the nitrogenous to the respiratory constituents of their food. The addition of bacon would be an admitted improvement upon a purely bread diet for a working man, for when it was considered that a given weight of the fat of the bacon, had about twice and a half the respiratory capacity of the starch of the bread, it would be easily seen how much the proportion of the nitrogen in the food would soon be diminished by the employment of the bacon. In the evidence which the statistics of food afforded, we had therefore, additional reasons for the conclusion, that a comparatively high percentage of nitrogen in flour and bread was by no means a safe test of their food value. He would only add, in reference to the discrepancy which there appeared between the average amounts of water found in bread, by Dr. Odling on the one hand, and Mr. Lawes and himself on the other, that the different modes of operating sufficiently accounted for the different results obtained. Dr. Odling's determinations were made upon the crumb or inner portion only of the loaf, which contained a larger proportion of water than the whole loaf. Their own determinations, however, were made upon entire loaves, in the condition, therefore, in which the bread in the bulk was sold by the baker and eaten by the consumer.

Mr. Dugald Campbell regretted that the lateness of the hour would not allow him to go into a full discussion of the paper, but, as a chemist, who had bestowed considerable attention upon the adulteration of substances generally, and substances of an alimentary nature particularly, he must say that the statements commonly put forth as regarded the use of alum in bread-making were, as the author of the paper had stated, very much exaggerated, and alarming to a degree truly unnecessary. He for one did not think that a small quantity of alum put into bread before baking it, so as to make it more *pleasing to the* eye, or for any other object, was calculated to be deleterious. He was not prepared to say that a large quantity of alum put into dough might not cause it, when consumed as bread, to be injurious, but he was prepared to say that such a quantity as would do an injury would render the bread unsaleable. He (Mr. Campbell) congratulated the meeting that the "anti-alum-in-bread" gentlemen had argued their case that evening in a milder form than generally, for usually he had heard them assert that they had found crystals of alum of the size of peas in bread. Now, he would ask how could this be unless alum were put into the bread after it came out of the oven for the purpose of deception, for the action of the oven upon dough with alum was entirely to decompose it, and the

alum could no longer be found in the bread or extracted from it as such. The fact was the alum was decomposed, the alumina being found in combination with the phosphoric acid as an insoluble phosphate of alumina, and it was by getting out this insoluble phosphate of alumina, and by the estimation of the alumina in it, that the amount of alum which had been used in the manufacture of the bread could be calculated. It was a much more difficult thing to do this correctly than persons generally imagined, and he (Mr. Campbell) agreed with the author of the paper that the process he had detailed as generally adopted was of no value, and by it alumina (that is what was supposed alumina by ignorant persons) was sure to be found in the bread, although it was known to have had no alum added. They had heard from a gentleman who had been extremely active about alum in bread, that he did not use this process, but a modification of it. He had detailed that modification, and he (Mr. Campbell) asserted that, even adopting that modification, he could not fail to get incorrect results, and that he could not get alumina alone as he declared, and, moreover, that he might get what was supposed to be alumina when no alum had been used in making the bread. They had heard that in every instance where that gentleman gave testimony that the bakers had put alum in their bread, they (the bakers) had confessed to having done so. Now, by mere accident, he (Mr. Campbell) happened to be in the court at Uxbridge where a prosecution of bakers was going on, and the chemical evidence was given by this very gentleman; he regretted to state he could not agree with him as to the perfect harmony of the bakers in the confession of their guilt. A most respectable and long-established baker of the place denied emphatically that there was alum put into his bread, and he brought evidence to prove that he did not use it; but the chemical witnesses, after this denial, although admitting that the quantity was in this instance extremely small, maintained that alum had been added, upon which evidence the man was fined, and left the court still protesting his innocence. He (Mr. Campbell) urged upon the meeting the necessity of receiving, with no moderate degree of caution, statements, upon chemical subjects, too often promulgated by medical men whose chemical experience was limited. For instance, lately they had had papers in journals, and letters in the *Times* and elsewhere, asserting that to live in rooms papered with green papers, was to subject ourselves to a slow poison, for the green of these papers contained arsenic, and arsenical fumes were continually being given off from it. He (Mr. Campbell) had been called upon professionally three times within the last six months by private individuals, who had become alarmed by their medical men, to investigate this subject, and he, in every instance, found that there was no occasion for any alarm whatever; there were no arsenical fumes given off even at a temperature of 140 degrees.

Mr. ALFRED SMEE would call the attention of Dr. Odling to one fact which he had omitted to notice; that was the influence of the process of cooking on the bread. A very important question was, how the bread should be baked. It was to be considered whether, by longer exposure to the heat of the oven the starch would not be rendered more soluble in the stomach. The outer crust of a loaf was more digestible than the interior, and he thought this point had not received sufficient attention. Having the care of a large institution, he had never been able to satisfy himself as to alum in bread having produced any specific effect. He was not prepared to deny that it might be so. The strong fact mentioned by Mr. Pittard should not be lost sight of—that alumina did not enter into the composition of any organic bodies. This fact would lead to the supposition that any small quantities of that substance taken into the system were excreted, and not absorbed. He believed no chemist had hitherto been able to find alumina in any part of the animal organisation, and the Germans had especially directed their researches in this direction.

Dr. NORMANDY entered into explanations in support of the accuracy of the analysis he had previously described.

Mr. T. K. CALLARD said, he, in common with many others engaged in the bread trade of London, was very anxious that the use of alum should be done away with in its manufacture. He did not deny that alum was extensively used, although many bakers did not employ it. They would be glad if scientific men would investigate the matter, and discover some less objectionable substance. Dr. Snow had mentioned a quantity of alum as having been found in bread that he (Mr. Callard) could not suppose to be possible. Such bread could not possibly be eaten, and he thought there must be some mistake as to the quantity. In the manufacture of bread, common salt was always used. Dr. Hassall had analysed salt, and all the ingredients for making bread, in order that he might see whether the alum was contained in the materials before they came into the bakers' hands, and the result was that he found alumina in the salt, and if that was the case, there would scarcely be a loaf of bread without the presence of this substance. It was therefore certain that before evidence could be given that a loaf was adulterated with alum, the chemist ought to be in a condition to state that he found more of this substance in it than could be due to the materials employed.

Dr. ODLING said that the question of the use of alum in bread involved two considerations, namely, whether or not it was fraudulent, and whether or not it was injurious. He considered that it was not fraudulent. The public demand in everything was for a good article at a low price, and manufacturers were justified in competing to supply that demand. There was a competition for price and a competition for quality, and the two balanced one another. Once upon a time a glue maker first introduced sulphate of zinc into his glue and size, whereby he was able to produce as good and durable glue and size as his neighbour obtained from higher priced materials. It was true he did not issue placards "size with white vitriol in it," but by means of white vitriol he effected a real improvement in the manufacture, and the public were eventually benefited by obtaining as good an article as previously at a lower cost. Now that alum improved the quality of bread made from inferior flour was indubitable, and admitting for the moment that it was not injurious to health, he considered that a baker was perfectly justified in using it, inasmuch as it enabled him to meet a popular demand, by furnishing an approved loaf at a low price. But he admitted, most fully, that if it should be proved that alum in bread was prejudicial to health, it must, at whatever cost, be dispensed with. But he contended that the use of small quantities of alum in bread had not been shown to be injurious. All arguments founded on the effects of alum *per se* were fallacious, inasmuch as it had been clearly proved by the investigations, first of Mr. L. Thomson, and then of several other chemists, that in bread alum no longer existed as alum, but underwent a most complete decomposition. Arguments founded on observation might be reliable, if different observers agreed. But one said it caused rickets; another, consumption; a third, constipation; a fourth, gastro-enteritis; and a fifth could not perceive any effect whatever. Now, in all cases of chronic poisoning, even by the most minute doses, whether of arsenic, lead, mercury, copper, or silver, &c., the symptoms, though not of an obtrusive character, were so characteristic that all observers recognised the same evils and ascribed them to the same cause. He admitted that alum might *occasionally* be present in such quantities as to do harm, but he contended that the prevalent notions on the subject were founded on prejudice and assumption, not upon dispassionate proof. He would reply *seriatim* to some of the remarks that had been offered. Dr. Normandy had described a process for the detection of alum, or rather alumina, and, although he could scarcely doubt in his own mind that the results Dr. Normandy had ob-

tained by that process, were really due to alumina, still he did not consider that they amounted to positive proof, and for his part, he should be sorry to go into a Court of Law and say upon oath that such results could not possibly have arisen from any other substance than alumina, or from any combination of substances. He considered, with Mr. Malone, that the final precipitate produced should be subjected to further examination. Moreover, Dr. Normandy must remember that even the process he described was an improvement upon M. Kuhlmann's. It was not the process described in books, an exact pursuance of which would frequently lead to the inference that wheat grain and wheat straw were frequently with alum. But he would also say that Dr. Normandy had described one process to the Society that evening, and another to the Parliamentary Committee not three years ago, which last-mentioned process Dr. Normandy now evidently knew to be utterly fallacious. He (Dr. Odling) still contended, and he would repeat it even more forcibly, that on the subject of alum in bread, there had been an enormous amount of loose and most discreditable chemistry given to the world, and he knew that many bakers had protested, as strongly as men could protest, against the pseudo-chemistry to which they had been exposed. Dr. Normandy had suggested that in the stomach the alumina and sulphuric acid and potash might reunite to form alum. But where was the proof? He (Dr. Odling) had caused a powerful and sure emetic, consisting of thirty grains of sulphate of zinc, to be mixed in a small bread-roll, whereby it became decomposed. Now the person who ate this roll, and he (Dr. Odling) saw it eaten, did not experience the slighest uneasiness of any kind. In this case the sulphuric acid and zinc certainly did not re-unite to form white vitriol! He admitted that M. Mège Mouries laid more stress upon the action of cerealin upon gluten as a cause of the brown colour of bread, than upon its action on starch. But he (Dr. Odling) considered that the conversion of starch into dextrine would of itself account for the browning. He objected to Dr. Snow's results, inasmuch as it was quite impossible for an eatable 4 lb. loaf, yielding only 1.17 per cent. of ash, to contain 1½ ounces of alum. Dr. Snow considered that alum in bread did not act positively as a poison, but simply by abstracting the nutritive substance, phosphate of lime or phosphoric acid. But alum did not remove any phosphoric acid whatever; and the phosphate of alumina really produced was soluble even in very dilute acids. Mr. Pittard's experience, that biscuit or baked flour was preferable to bread for feeding infants, had nothing to do with the question of alum. Inferior bread, without any alum, was very apt to turn sour and disagree. Mr. Varley's observation, that alum, added to imperfectly boiled paste, prevented the liquefaction of the starch when kept, was quite in accordance with his (Dr. Odling's) views. He considered the points raised by Mr. Malone and Mr. Smee of much importance. It might turn out that the maintenance of the integrity of the starch in bread was disadvantageous to its digestibility. In the crust of bread the starch always underwent considerable conversion. But at present the demand undoubtedly was for a white, crumbly, dry loaf.

The Chairman said they had derived much profit and instruction from the valuable paper of Dr. Odling and the discussion which followed upon it. At that late hour he would not trouble the meeting with any remarks of his own, but it was evident in the first place that the detection of alum in bread was a matter of no ordinary difficulty. The detection of alumina with organic matters and substances which contained phosphoric acid was an investigation requiring great nicety. Still there could be no doubt that alum was employed by bakers, and its presence had been indubitably detected in bread sold by them. On the other hand he thought it was not clear whether a small proportion of alum in bread was really injurious or not. Some medical gentlemen strongly condemned it, whilst others appeared not to attach any great importance to it. No doubt when alum was mixed with bread it became decomposed, in baking, and it did not appear to him that it could be reconstituted in the system. He was sure they would all agree with him, when he proposed a vote of thanks to Dr. Odling for his paper, which must have cost him a great deal of time and trouble to prepare.

A vote of thanks was passed to Dr. Odling.

The Secretary announced that on Wednesday evening next, the 14th inst., a Paper by Mr. J. MacGregor, "On the Paddle Wheel and Screw Propeller from the Earliest Times," would be read. On this evening Mr. J. Scott Russell, F.R.S., Vice-President of the Society, will preside.

THE LATE MR. HERBERT MINTON.*

A very large circle of his friends in all classes of society will regret to hear of the death of Mr. Herbert Minton, the most distinguished of English potters, which took place at Torquay, last week. The verdicts of two International Juries had assigned to Mr. Minton an European fame, and the chief place among manufacturers of pottery. Since the days of the first Wedgewood, no one had done so much to advance his art as Mr. Minton. Both at the London and Paris Exhibitions, his works proved that individual enterprise was more than a match for state subsidies. For its extensive variety of manufactures, earthenware, Majolica, Palissy, encaustic tiles, pressed powder mosaics, and porcelain for useful purposes, the single factory at Stoke-upon-Trent surpassed all the imperial manufactories at Sèvres, Meissen, Vienna, and Berlin. Only in decorative porcelain did Sèvres surpass the Stoke works. Mr. Minton inherited his factory from his father, and by his sole ability raised it to the first position among the potteries of Europe. He possessed in a remarkable degree that English pluck which never knows when it is beaten. For many years he battled against the difficulties in making pavement tiles and mosaics by machinery, sinking an immense capital year after year without any return. His perseverance was rewarded at last, and he established the manufacture as a truly national one, and witnessed the paving of the Houses of Parliament and the House of Representatives at Washington, of many of the palaces of Europe, and most of the new churches in England with his tiles. Mr. Minton was one of the first to discuss and promote the international feature of the Exhibition of 1851. He was the chief supporter of the School of Art at Stoke, and he attributed much of his success to the influence of the school. Whilst he was liberal in the extreme, he was a shrewd man of business. One of his earliest acts at the commencement of his prosperity was to build and endow a church at Hartshill, near Stoke; and before he had retired from business, which he did after the Paris Exhibition, he had built both schools and almshouses, and paved numberless churches throughout the length and breadth of the land. He made it his boast that he spent all his wealth, that he had no money in the funds, and possessed neither land nor shares, and was therefore free of all cares. He used to say that he could spend his money best himself to his own liking, and that he would not trouble his successors. There were but few charities to which he did not unostentatiously subscribe, and very many churches owe much to his bounty. He oftentimes declined to enter Parliament, but was made a Deputy-Lieutenant for Staffordshire, almost against his will. He was married three times, but has left no children. His flourishing business devolves upon his nephews.

* Communicated by a Member of the Society.

EAST LANCASHIRE UNION OF MECHANICS' AND OTHER INSTITUTIONS.

EXAMINATION AND PRIZE SCHEME OF MALE AND FEMALE CLASSES FOR 1858.

The East Lancashire Union of Mechanics' and other Institutions was formed to encourage and reward men and women in self-education.

The Council of the Union require a certificate, in the following form, from every candidate for examination :—

"The undersigned certify of personal knowledge that is a of sober, honest, and industrious habits, and attentive to the duties of station in life, and that has not been instructed at any higher than an elementary day school, Sunday school, evening class, Mechanics' or other Institution."

Any candidate who may bring this certificate, signed by his employer, or minister, or by the directors or president of his Institution or Evening School, will be admitted, after one month's notice, to the annual examination as a candidate for the certificates and prizes of the East Lancashire Union.

Before receiving any Institution or Evening Class into Union, so as to admit a member of its Committee to the Council of the Union, and to permit such Institution or Class to have the aid of the local and organising masters about to be appointed, the Council must be satisfied as to the character and efficiency of such Institution or Evening Class.

But the intention of the Council is to encourage and reward such persons, supported by manual labour, within the Union, as are making efforts for self-education, whether in evening schools, mutual instruction societies, or Mechanics' and other Institutions, or by their own solitary or partially-aided studies, irrespective of their connection with any Evening Class or Institution in Union, and they will require no other qualification for examination than the above-described certificate and notice.

The scheme for the Examination and prizes for the year 1857-8 will define to what candidates certificates will be granted. *Prizes* are open to competition, by exercises in the *English language and one additional subject.*

On each subject, in each class, candidates may take a rank of *competency*, *merit*, and of *highest merit.*

In each class there will be the following distinctions as to subjects :—

A.—*Exercises in English Language.*—First, second, and third class "English language certificates" will be granted to all who obtain marks of competency. The degree of merit will be carefully defined in the certificate.

B.—Any candidate who may obtain marks of *merit* in one subject, in addition to marks of *competency* or *merit* on the English language, will receive a book prize in addition to the certificate.

These certificates will be distinguished as *upper English language certificates* of the first, second, and third class.

C.—The candidates who obtain the required marks will obtain the *money prizes* and prize certificates.

The money prizes may, however, be received in books stamped with the arms of the East Lancashire Union, and an appropriate inscription if preferred.

To render these arrangements clear, the Council set forth in detail the three divisions of their requirements for *English language certificates*, *upper English language certificates* and *book rewards*, and for *money prizes with prize certificates.*

THIRD CLASS.

In the third class the Council require such elementary knowledge as is necessary in the common arts of life, and most important as a means of progress in self-education.

The second section of the third class will comprise :—1. English reading. 2. Writing from dictation with correct punctuation and spelling. A competent knowledge will be denoted by twenty marks on each subject. Thirty marks will denote merit, and sixty the highest merit. Any candidate gaining these marks of *competency* or *merit* will obtain a certificate for English language in the second section of the third class.

The *other subjects* in the second section will be :—(1) Arithmetic, as far as simple proportion, and (2) the geography of England, for each of which thirty marks will denote competency; forty, merit; and ninety, the highest merit. Any candidate obtaining marks of competency or merit in the English language, and marks of merit on one other subject, will obtain a book, in addition to his English language certificate, and a more valuable volume for marks of merit on an additional subject.

The first section of the third class will comprise—(1) Reading aloud with good articulation and expression. (2) Writing from dictation, with correct punctuation and spelling. (3) Writing from memory a simple narrative, read aloud twice by the candidates. (4) Writing a letter on some probable domestic occurrence, selected by the Examiner. It is not intended, in this class, to test the knowledge of spelling and grammar, otherwise than by these exercises.

Competence will be denoted by twenty marks; thirty will denote *merit*; and forty-five the highest merit.

A candidate gaining marks of competency in these exercises will obtain a *Certificate for English language* in the first section of the third class.

The other subjects in the first section of the third class will be (1) Arithmetic in the rules which commonly precede decimal fractions. (2) Geography of Great Britain, limited to the mountain chains, water-sheds and river drainage, and the situation of the coal-fields; all of which will be considered as affecting the sites of the chief ports, towns, and manufactures.

Thirty marks will denote competency; forty merit; and eighty-five the highest merit in geography and arithmetic.

A candidate obtaining marks of competency or merit in the English language, and marks of merit in one other subject, will obtain a book in addition to his English language certificate.

A more valuable volume will be given if marks of merit be obtained in a second additional subject.

THE MONEY PRIZES AND THE PRIZE CERTIFICATES IN THE THIRD CLASS.—SECOND SECTION.

The Council will award prizes of one pound to the six best candidates in the second section.

FIRST SECTION.

The Council will award prizes of two pounds to the five best candidates in the first section.

SECOND CLASS.—ENGLISH LANGUAGE EXERCISES.

Each candidate will be required :—(1) To analyse and parse, in writing, a passage of English. (2) To paraphrase a passage from verse into prose. (3) To repeat with proper expression, fifty lines from Cowper's "*Charity*," selected by the Examiner. (The whole poem or the first four hundred lines must in that case be committed to memory.)

Competency will be denoted by twenty-five marks; merit by thirty-five, and the highest merit by forty-five.

The remaining subjects in the second class will be :—(4). To work decimal fractions, and the usual rules in the mensuration of plane surfaces and solids. (5). To answer, in writing, questions on the geography of the British Islands and Empire. (6). To answer questions on the simple mechanical powers (lever, wheel and axis, pulley, wedge, screw).

Competency will be denoted by thirty marks; merit by forty marks; and the highest merit by sixty-five.

A candidate obtaining marks of merit on one subject besides the English Exercises will obtain a volume in addition to his English language Certificate. The highest merit will be denoted by four hundred marks.

The Council will award prizes of three pounds each to the eight best candidates who have marks of merit on each subject, or marks of merit equal to the sum of such marks.

First Class.—English Language Exercises.

(1). The candidate may write his own thoughts on any of the following subjects, viz.:—

On the best mode of educating a boy born in this country of parents supported by manual labour, or on the best course of self-education for a young man of the working class, after leaving the daily school; or on the comparative cost in money of self-education, and of habits of self-indulgence; or on household economy, as for example, the selection of a house, as respects the healthiness of the site—its drainage—method of warming and ventilation—arrangements for the comfort and morality of the family. Also on the best modes of preventing the spread of a contagious disease in a household, and of disinfecting a house which has been visited by such a malady.

(2). He will be required to analyse and parse a passage from one of the English poets, and to explain its construction fully in writing.

Competency will be denoted by forty marks; merit by sixty, and the highest merit by eighty.

The remaining subjects of examination in the first class may be any of the following:—four of them at least must be successfully worked to entitle a candidate to a Money Prize.

Any candidate may be examined orally and by written questions on Paley's Natural Theology; the History of England, since the Accession of Elizabeth; in Algebra or in Tate's Mechanics; the History, Theory, and Construction of the Steam Engine; Chemistry, especially in its application to manufactures and agriculture.

Competency will be denoted by thirty marks; merit by fifty; and the highest merit by eighty-five.

A candidate obtaining marks of merit on any one of these subjects, in addition to marks of competency on the English Exercises, will obtain a volume in addition to his English Language certificate.

The highest merit will be denoted by five hundred marks.

The Council will award prizes of five pounds each to the six candidates who having marks of merit in each subject of the English exercises, and on four other subjects, or marks of merit equal to the sum of such marks, have also the highest number of marks among the competitors.

Any candidate may be examined in mathematics, or in any department of natural science not named, by giving notice to the Examiners, one month before the examination, of the nature and extent of his acquirements, in order that an examination paper may be prepared to test his knowledge. He will have credit for any marks thus gained. The three degrees of competency, merit, and the highest merit, will be denoted by thirty, fifty, and eighty-five marks respectively.

No candidate will be admitted to examination in the class in which he obtained a money prize in a former year. If unsuccessful, he may enter that or a higher class—if successful, he can compete in future only in a higher class.

The Council being also desirous to encourage Evening Schools for females, and Female Evening Classes in connection with the several Institutions, propose that the foregoing scheme, so far as it relates to the English exercises, shall be applicable to such classes with the following special adaptations:—

The Council will grant to females, *Certificates* for marks of *competency in three classes of English Exercises—and Book Prizes* for *marks of merit.*

They will also, to all females who obtain marks of merit in any of the three classes of English exercises, award prizes of greater value in books or money, provided marks of merit be obtained in an exercise in one of the following subjects.

Third Class.—Females.

Second Section.—Arithmetic as far as compound division.

First Section.—Arithmetic as far as Practice. The candidate will also answer questions as to the best application of the earnings of a working man's family (the ages of each member of which will be given), for food under several heads, for clothing, for the Sick club or Life Assurance Society, or Savings Bank, stating how much of the income should be spent on each.

Second Class.—Females.

In this class the female candidates who compete for the higher prizes will answer questions on the following subjects.

Food.—The best materials for the meals of a working man—the prices of each article of food—the amount of nourishment which it contains—and the best mode of cooking it.

Clothes.—The most durable, warm, and cheap clothing for women and children within the means of a family supported by manual labour. How to cut out, make, mend, and preserve clothes, in a neat and wholesome condition; also exercises in household account keeping.

First Class.—Females.

Will show books of household accounts neatly kept as exercises in their classes.

They will answer, in writing, questions on the prices of food, clothing, furniture, and other objects of expenditure in a labourer's family, and will work calculations of the cost.

They will write their thoughts on one of the following subjects.

Household Arrangements.—How to regulate and improve the ventilation of a cottage by simple and cheap means. How to keep floors, bedding, furniture, walls and utensils in a perfectly wholesome condition.

Management of Children.—In Health.—What precautions to take against colds, coughs, chilblains: against contagious diseases—and in their daily regimen and habits. *In Sickness.*—How to keep a sick room—to prepare food for various infantile complaints—for a general feverish disorder—to give simple medicines for common wants—to dress a burn or scald: a bruise or a cut.

What "*nostrums*" and ill practices to avoid, in bringing up and nursing children.

Moral Arrangements.—As regards cleanliness, obedience, truthfulness, purity of language, reverence, religious duties.

Sickness in Adults.—How to prepare whey—beef-tea—mutton-broth—barley-water—lemonade—effervescing draughts—poultices. How to bandage a leg or arm—to stop a sudden bleeding—to manage a "fainting fit"—and to soothe and comfort the sick and dying.

In order to enable young women to gain a competent knowledge of domestic sanitary arrangements and management of children and the sick, the Council of the East Lancashire Union would suggest that no more laudable service could be rendered to females *in attendance* on the Evening Classes in the Union than a series of familiar lessons on these subjects from practitioners of medicine.

Such lessons would prevent much suffering and save many lives.

Other lessons on household economy might be given in the form of conversation, by ladies, to the Sewing Classes.

The Council strongly urge that Female Classes should be organized for this form of instruction throughout the East Lancashire Union.

The Council will require specimens of needle-work, cutting out clothes, and making ordinary linen and cotton garments. They will request the aid of experienced ladies in determining the merit of this work.

The Council suggest that the class-rooms of the several Institutions should be neatly fitted up with groups of parallel desks and benches suitable for the instruction of classes of 18 or 21 in three rows of six or seven pupils each. Such groups of desks and benches facilitate that collective teaching which it will be the duty of the organizing masters to introduce, where it does not at present exist. The classes should also be provided with black-boards, easels, maps, class-lesson books, and slates.

The Council recommend the directors of the several Institutions to take steps to have the instruction in their evening classes regulated, so as to prepare their pupils for examination, especially by accustoming them to written exercises. They also suggest that, in the month of March and April preliminary examinations should be held in each Institution of all pupils desirous to become candidates; and each pupil should, after such examination, be advised as to the class in which he should enter his name.

The examinations will be conducted by one or more impartial persons selected by the Council.

It will be partly oral, but chiefly by means of written answers to printed questions, which will be put before each candidate.

The candidates will answer these questions without any assistance from books or from each other, and write them in the presence of the examiners. When the answers are finished, they will be sealed up, and sent to some gentleman unknown to the parties, who will assign marks to each paper. As soon as this is done, the successful candidates will be declared.

The Prizes will be distributed publicly.

The chief employers of labour in the district have declared, that they will attach much value to the certificates granted by the Council as proofs of meritorious exertion, correct life, and mental capacity, in giving employment or promotion. It is hoped that they will acquire a distinct mercantile value, and promote the commercial advancement of successful candidates.

The Council have purposely not specified skill in art in the list of subjects of examination, because they propose to award separate prizes for such skill.

The prizes will be divided as follows:—

1. Drawing of form from Models and Diagrams, on the method published by Mr. Butler Williams.
2. Map and Plan Drawing, for Surveyors of Land, &c.
3. Mechanical Drawings, including Machinery, Tools, and Working Drawings, of Buildings, Carpenters' Work, Masons' Work, Excavations, &c.
4. Architectural Drawings.
5. Industrial designs for all the trades of the District.
6. Drawing of the Human Figure.

Special arrangements will be made for the examination of the progress of pupils in the several Schools of Design, and for testing their ability; and a prize will be awarded under each of the above heads.

SOUTH KENSINGTON MUSEUM.

During the week ending 3rd April, 1858, the visitors have been as follows:—On Monday, Tuesday, and Saturday, free days, 3,713; on Monday and Tuesday, free evenings, 3,449. On the two Students' days (admission to the public 6d.), 409; one Students' evening, Wednesday, 276. Total 7,897.

PARLIAMENTARY REPORTS.

PRINTED SESSIONAL PAPERS.

Parl. No.

Delivered on 20th and 22nd March, 1858.

Second Session, 1857.

77 (C). Poor Rates and Pauperism—Return (C).

Delivered on 23rd March, 1858.

83. Public Offices (Downing-street)—Copy of Correspondence.
122. Duchy of Lancaster—Account.
130. Income Tax Collectors (Tynemouth)—Return.
141. Railway and Canal Bills—1st Report from the General Committee.

Delivered on 24th March, 1858.

120. Poor Law Medical Relief (Scotland)—Returns.
127. Sandhurst College—Return.
128. Bands, &c.—Return.
133. Hops—Return.
139. Shipping—Return.

Delivered on 25th March, 1858.

123. Printed Papers—Return.
143. Civil Services—Estimate to Votes "on Account."
146. Committee of Selection—Fifth Report.
147. Army (Educational and Scientific Branches)—Supplementary Estimate.
121. Oxford University—Copies of two Ordinances.
117. Railway and Canal Bills (70. Athenry and Tuam Railway; 71. Ballymena, Ballymoney, Coleraine, and Portrush Junction Railway; 72. Banbridge, Lisburn, and Belfast Railway; 73. Belfast and County Down Railway; 74. Dublin and Meath Railway; 75. Great Northern and Western of Ireland Railway; 76. Limerick and Castle Connell Railway; Leitrim Railway and Lough Allen Pier; 77. Waterford and Kilkenny Railway (Capital); 78. Waterford and Kilkenny Railway (Power of Purchase, &c.)—Board of Trade Reports.
38. Bills—Customs Duties.

MEETINGS FOR THE ENSUING WEEK.

Mon. .....Architects, 8. Mr. C. R. Cockerell, "Some Remarks on the old Vatican Basilica, and its conformity to the Christian rules of Building known to us, of subsequent date."
Geographical, 8½. I. Dr. H. Rink, "On the Supposed Discovery of the North Coast of Greenland and an open Polar Sea, &c., by Dr. Elisha Kent Kane, U.S. Navy." II. Mr. Wm. Lockhart, "On the importance of Opening the Navigation of the Yang-tse-kiang, and the changes that have lately taken place in the bed of the Yellow River, &c."

Tues.....Royal Inst., 3. Mr. J. P. Lacaita, "On the History of Italy during the Middle Ages."
Syro Egyptian, 7½. Mr. Thos. Sopwith, "On the Progress of Modern Improvements in Egypt."
Civil Engineers, 8. Mr. G. Robertson, "On the Theory and Practice of Hydraulic Mortar."
Med. and Chirurg., 8½.
Zoological, 9.

Wed. .....United Service Inst., 3. Mr. John Craufurd, "On India, as connected with a Native Army."
Literary Fund, 3.
Archæological Asso., 4. Anniversary.
Society of Arts, 8. Mr. J. MacGregor, "On the Paddle Wheel and Screw Propeller, from the Earliest Times."
Chemical, 8. Dr. Odling, "On Atoms, Molecules, and Equivalents."
Geological, 8.
Graphic, 8.

Thurs. ...Royal Inst., 3. Prof. Tyndall, "On Heat."
Antiquaries, 8.
Linnean, 8.
Royal, 8½.

Fri. .....United Service Inst, 3. Capt. Tyler, "On the Effect of the Modern Rifle upon Siege Operations, and the means required for counteracting it."
Royal Inst., 8½. Mr. Robert Godwin Austen, "On the Conditions which determine the probability of Coal beneath the South-Eastern parts of England."

Sat.....Royal Inst., 3. Mr. Edwin Lankester, "On the Vegetable Kingdom in its relations to the life of Man."
Medical, 8.
Asiatic, 8½. Mr. Cyril C. Graham, "On the Ethnology of Syria and Palestine, from the earliest times down to the present."

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, April 2, 1858.*]

Dated 1st Dec., 1857.

2982. J. Young, Glasgow—Imp. in measuring liquids.

Dated 16th Feb., 1858.

292. R. Anderson and J. J. Prescott, Duke-street, Liverpool—Imp. in lubricators.

Dated 18th Feb., 1858.

306. J. Piddington, 77, Montagne de la Cour, Brussels—Imp. in the manufacture of fuel, commonly called artificial or patent fuel.

Dated 20th Feb., 1858.

328. T. Metcalf, Newton Heath, Manchester—Imp. in the purification of crude tar oil, rendering the same suitable for lubricating machinery and other similar purposes.

Dated 3rd March, 1858.

420. J. Gowing, Poplar, and H. Bull, Greenwich—Imp. in apparatus for preventing smoke, applicable to tubular boilers.

Dated 9th March, 1858.

478. F. C. Warlich, Hope-cottage, Gloucester-place, Kentish-town—Imp. in apparatus for generating steam.

Dated 11th March, 1858.

490. A. J. Holdsworth, Leeds—A safety railway oral communication.
492. G. T. Bousfield, Loughborough-park, Brixton—Imp. in knitting machines. (A com.)
494. J. D. Leathart, Newcastle on-Tyne—Imp. in furnaces.

Dated 12th March, 1858.

496. A. Porecky, 7, York-street North, Hackney-road—Imp. in the manufacture of the frames of umbrellas and parasols.
500. T. Thompson, Radbourne, Derby—Imp. in vats for cheese making.
502. W. Pearson, Brierley-hill, Staffordshire—A new or improved washing machine.
504. J. Wright, 19, Alfred-place, Newington-causeway, Southwark—Imp. in the treatment of machine-made malleable iron nails. (A com.)
506. A. V. Newton, 66, Chancery-lane—A new combination of instruments for extracting teeth. (A com.)

Dated 13th March, 1858.

510. C. Tilliere, Brussels—Certain imp. in machinery for forging, planing, and stamping cold or heated metals.
512. G. Pigott, Nottingham—Imp. in Jacquard machinery for figuring lace and other fabrics.
516. A. V. Newton, 66, Chancery-lane—Improved machinery for making horse shoes. (A com.)

Dated 15th March, 1858.

518. J. C. Martin, Fern cottage, Charlewood-road, Putney—An improved plastic compound for the manufacture of moulded articles, to be used as a substitute for wood carvings, and for many of the purposes to which papier maché is applicable.
522. R. A. Brooman, 166, Fleet-street—Imp. in sewing machines. (A com.)
528. J. Hamilton, jun., Liverpool—Imp. in apparatus for propelling vessels.
530. J. F. Empson, junr., Birmingham—An imp. or imps. in ornamenting certain kinds of buttons.

Dated 16th March, 1858.

532. D. Gallafent, Stepney Causeway—Certain imps. in machinery or apparatus for cooling liquids and condensing vapours.
534. M. Henry, 77, Fleet-street—Imp. in the manufacture or production of artificial marble, frescoes, and decorative, ornamental, and artistic surfaces, objects, and works. (A com.)
536. J. Lawson, Hope Foundry, Leeds—Imp. in machinery used in spinning flax and other fibrous substances.

Dated 17th March, 1858.

538. W. S. Clark, Atlas Works, Upper Park-place, Dorset-square—Imp. in machines for cutting and harvesting grain and grass crops. (A com.)
539. C. F. Vasserot, 45, Essex-street, Strand—Imp. in the treatment of horn, and in the application of it when so treated as a substitute for whalebone in the manufacture of umbrellas, parasols, and similar objects. (A com.)
540. D. Nicoll, 114, Regent-street—Imp. in machinery for cutting out military, naval, and police uniforms, and other clothing.
541. W. Todd and J. Todd, Heywood, Lancashire—Certain imp. in power looms for weaving, and in shuttles to be employed therein.
543. J. Gooderham, John's-cottage, Mathias-street, Kingsland—Imp. in shoemakers' wax.
544. W. C. Beatson, Masbro', Yorkshire—Imp. in apparatus to be used in the manufacture of glass bottles.
545. T. C. Hine, Nottingham—Imp. in lighting and ventilating by gas.
546. T. Evans, Hanover-street, River-terrace, Islington—Imp. applicable to the manufacture of parasols.
547. R. A. Brooman, 166, Fleet-street—Imp. in the construction of boxes or cases for trees, flowers, and other horticultural and floricultural purposes. (A com.)
548. W. Ward, Smethwick—New or improved machinery for the manufacture of nails, spikes, bolts, rivets, screw blanks, and nuts.
549. J. Oxley, Beverley, Yorkshire—An elastic cushion or fitting piece for windows, blinds, shutters, and doors, which is also applicable for other purposes.

Dated 18th March, 1858.

551. R. Glanville, Bermondsey—Imp. in condensing steam engines.
553. J. Webster, Birmingham—Certain new or improved metallic alloys.
555. A. Dunlop and A. Stark, Moor Park Mill, Renfrew, N.B.—Imp. in dressing or sifting flour and meal or reduced grain.
557. R. A. Brooman, 166, Fleet-street—An improved knee cap. (A com.)
559. R. Townend and W. Townend, Bradford—Imp. in piston-valve musical instruments.
561. A. A. Croll, Coleman-street—Imp. in the manufacture of parts of dry gas meters.

Dated 19th March, 1858.

563. P. F. Aerts, Brussels—Imp. in the construction of railway rolling stock, and in the lubrication thereof, and other moving parts of machinery.
565. G. Scott, Manchester—Imp. in generating elastic fluids, and in apparatus for that purpose.
567. W. H. Rhodes, Oldham—Imp. in speed indicators and calculators.
569. T. C. Medwin, 10, Clayton-place, Kennington-road—Certain imp. in the construction of water guages for steam boilers.
571. D. Evans, 15, Railway-terrace, New-town, Stratford—An imp. in apparatus for supplying air in streams to furnaces.
573. J. Young, Knaresboro'—Imp. in chronometers, clocks, and watches.

Dated 20th March, 1858.

575. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Certain imp. in the piercing of tunnels. (A com.)
579. L. Cowell, Adelphi—Imp. in machinery or apparatus for teaching the art of swimming.
581. R. Mills, Bury—Imp. in washing machines.
583. J. Biggs and W. Biggs, Leicester—An imp. in the manufacture of polkas when looped or elastic fabrics are used.
585. J. Le Franc, 58, Aldersgate-street—Imp. in pressure guages. (A com.)
587. W. E. Newton, 66, Chancery-lane—An improved mode of treating and combining various combustible matters or substances for the production of artificial fuel. (A com.)

Inventions with Complete Specifications Filed.

577. D. Harris, Massachusetts, U.S.—A new and useful or improved sewing machine. (20th March, 1858.)
648. R. Williams, 8, Bishop's-road, Victoria-park—An imp. for manufacturing a soap for cleansing, bleaching, and purifying purposes.—27th March, 1858.

WEEKLY LIST OF PATENTS SEALED.

April 1st.

2523. J. M. Napier.
2527. A. Illingworth and H. Illingworth.
2529. J. S. Willway.
2537. W. Riley and T. Riley.
2545. J. Rubery.
2548. R. Atkinson.
2555. E. Cavendy.
2557. R. H. Hughes.
2560. R. A. Brooman.
2564. W. Knapton.
2566. J. Warburton.
2569. W. Gossage.
2577. W. G. Craig.
2585. G. Scott.
2597. C. N. Leroy.
2650. W. Holroyd and S. Smith.
2665. J. J. Sieber.
2693. A. H. C. Chiandi.
2749. D. Allison and J. Livingston.
2803. C. Clay.
3113. J. M. Napier.
110. P. Wilson, S. Northall, and T. James.
213. A. Crichton and M. Whitehill.

April 6th.

2563. G. T. Robinson.
2574. T. Grubb.
2600. W. H. Myers.
2628. F. H. Holmes.
2635. W. A. Rooke.
2649. J. Wright.
3139. A. C. Kennard.
166. J. Wotherspoon.
192. J. Gray.
252. J. Chatterton.

Patents on which the Stamp Duty of £50 has been Paid.

March 27th.

418. A. E. L. Bellford.

March 29th.

708. W. Swain.
710. G. H. Babcock and A. M. Babcock.
752. C. Nickels and J. Hobson.

March 30th.

231. R. A. Brooman.

March 31st.

1865. J. H. Tuck.

April 1st.

729. F. Phillips.
736. W. Lund and W. E. Hipkins.
737. F. T. Botta.
748. H. R. Fanshawe and J. A. Fanshawe.
755. L. A. M. Mouchel.

April 3rd.

742. H. Powers.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4069	March 25.	Improved Solid Rule Joint	Griffiths and Hughes	Birmingham.
4070	,, 25.	The Smokers' Sweetheart	A. Smart and J. Howland	Fenchurch street, City.
4071	,, 26.	Reading Stand	Rev. A. W. Noel	Cropredy, Oxon.
4072	,, 27.	Prismatic Reflector for Ceiling Gas Lights	W. Wilson	King-street, Manchester.
4073	April 6.	Tag or Fastener	M. Lyons	Suffolk, Birmingham.